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13. SUPPLEMENTARY NOTES

14. ABSTRACT

The United States Air Force School of Aerospace Medicine Detachment 3 performed an evaluation of potential ammonia exposures at the Eielson Air Force Base (EAFB) Central Heat and Power Plant (CHPP) following the installation of a new boiler and emission controls. While the main purpose of the visit was an ammonia health risk assessment, the potential exposure to coal dust and silica was identified as a greater risk to CHPP employee health. Det 3 personnel informed Eielson Bioenvironmental Engineering personnel of the Occupational Safety and Health Administration *Occupational Exposure to Respirable Crystalline Silica; Proposed Rule*. This consultative letter is in addition to the main ammonia health risk assessment letter and designed to inform EAFB of the status of the pending silica rule, exposure assessment strategies, occupational and environmental exposure limits, and air sampling methods as they apply to CHPP operations.

15. SUBJECT TERMS

Silica, crystalline, coal dust, power plant, health risk assessment, 1910.1053

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a. REPORT	b. ABSTRACT	c. THIS PAGE			Capt Tiffany Heline
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DEPARTMENT OF THE AIR FORCE
DETACHMENT 3, USAF SCHOOL OF AEROSPACE MEDICINE (AFMC)
KADENA AIR BASE JAPAN

11 December 2014

MEMORANDUM FOR 354 MDOS/SGOJ

FROM: Detachment 3, USAF School of Aerospace Medicine (USAFSAM)
Unit 5213, Bldg 850
APO AP 96368-5213

SUBJECT: Consultative Letter, AFRL-SA-WP-CL-2014-0016, Central Heat and Power Plant Coal Dust and Silica Risk Management, Eielson Air Force Base, Alaska

1. INTRODUCTION:

a. *Purpose:* On 12-22 August 2014, the United States Air Force School of Aerospace Medicine Detachment 3 (USAFSAM/Det 3), at the request of 354 MDOS/SGOJ, performed an evaluation of potential ammonia exposures at the Eielson Air Force Base (EAFB) Central Heat and Power Plant (CHPP) following the installation of a new boiler and emission controls. While the main purpose of the visit was an ammonia health risk assessment, the potential exposure to coal dust and silica was identified as a greater risk to CHPP employee health. Det 3 informed Eielson Bioenvironmental Engineering personnel of the Occupational Safety and Health Administration (OSHA) *Occupational Exposure to Respirable Crystalline Silica; Proposed Rule*. This consultative letter is in addition to the main ammonia health risk assessment letter, AFRL-SA-WP-CL-2014-0014, and designed to inform EAFB of the status of the pending silica rule, exposure assessment strategies, occupational and environmental exposure limits (OEELs), and air sampling methods as they apply to CHPP operations. This letter also serves as an update to the CHPP risk assessment performed by Det 3 in 2006.[1]

b. *Survey Personnel:* USAFSAM/Det 3, Chief, Occupational Health

c. *Personnel Contacted:*

(1) 354th MDOS, Bioenvironmental Engineering Flight Commander
(2) 354th MDOS, NCOIC, Occupational Health
(3) 354th CES, CHPP Acting Plant Manager
(4) 354th CES, CHPP Operations Supervisor

[1] Caravello V. Coal power plant; process assessment & evaluation, Eielson Air Force Base, Alaska. Kadena AB: Detachment 3, Air Force Institute for Operational Health; 2006. Consultative Letter AFIOH-DO-BR-CL-2006-0062.

2. BACKGROUND:

a. *CHPP Mission:* The CHPP provides essential utilities to EAFB and is currently configured as a 25-MW coal-fired co-generation plant. It provides both primary electric energy and primary thermal energy, in the form of steam, to the base. The plant contains six coal-fired stoker steam water tube boilers using coal provided from the Usibelli coal mine, located in Healy, Alaska. The coal, generally classified as subbituminous, is delivered via the Alaska Railroad. The power plant operates 7 days per week, 24 hours a day. More than 500 tons of silica-containing coal is burned per day. Det 3 last visited the CHPP in 2006 to perform a process assessment and health risk evaluation; the findings were documented in AFIOH-DO-BR-CL-2006-0062 (see footnote 1).

b. *Silica Health Hazards:* Workers who inhale very small crystalline silica particles are at an increased risk of developing serious silica-related diseases. Respirable silica can penetrate deep into workers' lungs and cause silicosis, an incurable and sometimes fatal lung disease. The early signs of silicosis (cough, mucous production, and shortness of breath upon exertion) are nonspecific, so the development of silicosis may not be detected until advanced stages of the disease. The International Agency for Research on Cancer has concluded that crystalline silica in the form of quartz should be classified as carcinogenic to humans (Group 1) due to an increased risk of developing lung cancer. In addition to cancer, occupational exposure to respirable silica may result in the development of kidney and autoimmune diseases and in death from other nonmalignant respiratory diseases, including chronic obstructive pulmonary disease. There are some additional health effects from coal dust exposure that differ from silica exposure. All are associated with lung damage and they include pneumoconiosis, bronchitis, and emphysema. Coal dust with a silica percentage less than 5% is not considered to be a carcinogen.

3. FINDINGS AND DISCUSSION:

a. *Regulatory Update, OSHA's Proposed Rule:* OSHA's current permissible exposure limits (PELs) for crystalline silica were adopted in 1971 and have not been updated since that time. According to OSHA's *Occupational Exposure to Respirable Crystalline Silica; Proposed Rule*, the current PELs "do not adequately protect workers; they are outdated, inconsistent and hard to understand. Strong evidence shows that current PELs do not adequately protect worker health. The current PELs are based on research from the 1960s and earlier and do not reflect more recent scientific evidence. For example, since the current PELs were adopted, the U.S. National Toxicology Program, the International Agency for Research on Cancer, and the National Institute for Occupational Safety and Health have all identified respirable crystalline silica as a human carcinogen." [2] To address these issues, OSHA's Notice of Proposed Rulemaking for *Occupational Exposures to Respirable Crystalline Silica* was published in the Federal Register on 12 September 2013. The proposed rule seeks to lower worker exposure to crystalline silica. In addition to lowering the PEL, OSHA is proposing other elements of a comprehensive health standard including requirements for exposure assessment, methods for

[2] Occupational Safety and Health Administration. Occupational exposure to respirable crystalline silica. Proposed rule, 78 FR 56273, 29 CFR 1910, 1915, 1926. Washington, DC: OSHA; 2013. Retrieved 1 September 2014 from https://federalregister.gov/a/2013-20997.

controlling exposure, respiratory protection, medical surveillance, hazard communication, and recordkeeping. A public comment period was held from 18 March to 4 April 2014. Moving forward, OSHA will review all written comments then develop and publish a Final Rule. The process from public comment to publication can take as little as 24 months, meaning a Final Rule may be published as early as 2016. If adopted, the proposed rule will make silica an OSHA expanded standard regulated under 29 CFR 1910.1053.

b. *Occupational and Environmental Exposure Limits:* The two most cited propagators for silica and coal dust exposure standards include the OSHA and the American Conference of Governmental Industrial Hygienists (ACGIH). OSHA's proposed rule seeks to lower the PEL for silica.

(1) Respirable Silica OEEL. The 2014 ACGIH threshold limit value (TLV) 8-hour time weighted average (TWA) for silica is 0.025 mg/m^3, with an A2 designation as a potential human carcinogen. The OSHA PEL as an 8-hour TWA for respirable crystalline silica is currently calculated using a formula found under the general industry standard for mineral dusts at Table Z-3 of 29 CFR 1910.1000. The formula generates a specific standard for the dust exposure based on the silica content given as 10 mg/m^3 divided by the value "%SiO_2 + 2." The proposed OSHA PEL would be defined under the expanded standard 29 CFR 1910.1053(c), removed from Table Z-3, and no longer based on the percent of silica but rather an established value of 0.05 mg/m^3 regardless of percent silica content (Table 1). The PEL defined in the proposed rule significantly reduces acceptable silica exposures (up to 1/28th of the original PEL). The ACGIH-TLV is based solely on health factors; there is no consideration given to economic or technical feasibility. For this reason, the TLV is half of the proposed OSHA PEL. OSHA determined that a PEL of 0.025 mg/m^3 would not be feasible (that is, engineering and work practices would not be sufficient to reduce and maintain silica exposures to a PEL of 0.025 mg/m^3 or below in most operations most of the time in the affected industries) and hence selected a higher PEL of 0.05 mg/m^3. It is Det 3's recommendation that the lower ACGIH-TLV be adopted when determining administrative and personal protective equipment requirements for CHPP operations. Det 3 recommends the OSHA PEL of 0.05 mg/m^3 be used for determining the need for additional engineering controls. Contrary to the OSHA finding, if at any time the CHPP determines it economically feasible, engineering controls shall be installed to reduce employee exposures to 0.025 mg/m^3.

Table 1. Silica OEELs

Respirable Silica, Crystalline OEEL		
Existing OSHA PEL	$\frac{10\ mg/m^3}{Quartz\%+2}$ =	0.098 mg/m^3 (100% silica) to 1.429 mg/m^3 (5% silica)
ACGIH TLV		0.025 mg/m^3
Proposed OSHA PEL		0.050 mg/m^3

(2) Respirable Coal Dust OEEL. In addition to silica OEELs, ACGIH and OSHA have separate standards for respirable coal dust. The ACGIH coal dust TLV is based on coal type, either bituminous/lignite or anthracite. The coal used at the CHPP is classified as subbituminous, so the bituminous TLV of 0.9 mg/m^3 is recommended. In contrast to ACGIH,

OSHA regulates coal dust exposure based strictly upon the amount of silica in the coal. The OSHA PEL for coal dust is calculated in the same manner as silica using the formula found under the general industry standard for mineral dusts at Table Z-3 of 29 CFR 1910.1000. When the silica percentage is below 5%, the PEL for coal dust is set at 2.4 mg/m^3 (Table 2). Det 3 recommends using the ACGIH-TLV for coal dust.

Table 2. Coal Dust OEELs

Respirable Coal Dust OEEL	
Existing OSHA PEL	Greater than 5% silica: $\frac{10\ mg/m^3}{Quartz\%+2}$ = 0.098 mg/m^3 (100% silica) to 1.429 mg/m^3 (5% silica) Less than 5% silica = 2.4 mg/m^3
ACGIH TLV (Bituminous)	0.9 mg/m^3
ACGIH TLV (Anthracite)	0.4 mg/m^3
Proposed OSHA PEL	NA

c. *Sampling and Analysis:* Collection of respirable samples for both silica and coal dust should use matched-weight or pre-weighed filters and a cyclone following NIOSH [National Institute for Occupational Safety and Health] Manual of Analytical Methods (NMAM), Method 7500, *Silica, Crystalline, by XRD* [X-ray diffraction], and 0600, *Particulates Not Otherwise Regulated, Respirable*. This analysis is conducted by a contract laboratory; technicians should contact the USAFSAM lab prior to sample collection to ensure funding is available. The contract lab reporting limit for NMAM 7500 is 10 µg/sample. The minimum air volume required to compare results to the ACGIH TLV action level, or 0.0125 mg/m^3, is thus calculated:

$$Minimum\ Air\ Collection\ Volume\ (L) = \frac{(Reporting\ Limit, \mu g) \times \left(\frac{1\ mg}{1000\ \mu g}\right) \times \left(\frac{1000\ L}{1\ m^3}\right)}{\left(OEEL\ \frac{mg}{m^3}\right) \times \left(Desired\ Fraction, \frac{1}{2}\right)}$$

$$Minimum\ Air\ Collection\ Volume\ (L) = \frac{(10\ \mu g) \times \left(\frac{1\ mg}{1000\ \mu g}\right) \times \left(\frac{1000\ L}{1\ m^3}\right)}{\left(0.025\ \frac{mg}{m^3}\right) \times \left(\frac{1}{2}\right)} = 800\ L$$

Depending on the type of cyclone used, this translates to the following minimum and maximum sampling times presented in Table 3. Sample collection times lower than the recommended range may generate concentrations ***below*** the laboratory reporting limit but ***above*** the ACGIH TLV action level. Collection times higher than the range identified below are not recommended in accordance with (IAW) the published method. Special consideration should be given to shifts lasting longer than a single sample collection period. Consecutive samples will have to be collected with special attention paid to each individual sample time to ensure non-detect results remain below the action limit (i.e., for 12-hour shifts, two consecutive samples using either the aluminum or Higgins-Dewell cyclone collected for 360 minutes each will be

sufficient; with the lower flow rate of the nylon cyclone, there will be insufficient time to collect two consecutive samples at the minimum sample volume). Historically, samples below the laboratory detection limit ***but*** above the action level have been an issue for CHPP risk assessments.

Table 3. Minimum Air Sample Collection Time

Cyclone	Flow Rate (lpm)	Min Collection Time (min)	Max Collection Time (min)
Dorr-Oliver Nylon	1.7	470	583
Aluminum	2.5	320	400
Higgins-Dewell	2.2	364	455

OSHA is proposing specific requirements, outlined in the proposed rule 29 CFR 1910.1053 (d)(5)(ii), for laboratories that perform analyses of respirable silica samples. The rationale is to improve the precision in individual laboratories and reduce the variability of results between laboratories. The proposed rule includes provisions for samples to be analyzed by laboratories meeting defined performance criteria including but not limited to ISO 17025 accredited, round robin participation, and National Institute of Standards and Technology traceable standards. The USAFSAM contract laboratory, Bureau Veritas North America Inc. (BVNA), is an American Industrial Hygiene Association (AIHA) accredited laboratory with NMAM 7500 as an approved field of testing. BVNA can meet the OSHA proposed limit of detection requirements; however, at this time there is still concern that the performance data for NMAM 7500 (and OSHA ID-142) do not consider matrix effects and therefore may not be reflective of method performance with real world samples. Additionally, the XRD method has an inherent lower level of precision at concentrations below 0.05 mg/m^3. BVNA's concerns were formalized when they testified in front of the OSHA committee overseeing the revision of the rule in October 2013.[3] During subsequent silica exposure assessments, risk assessors should be aware of the current state of the science in silica analytical testing and stay abreast of changing technology capabilities and limitations.

d. *Exposure Assessments:* IAW the proposed rule 1910.1053(d)(1)(i), the employer is responsible for conducting initial and periodic exposure assessments. Where initial or subsequent monitoring reveals employee exposures are at or above the action level but below the PEL, the employer shall repeat such monitoring every 6 months. When exposures are above the PEL, monitoring shall be repeated every 3 months. EAFB Bioenvironmental Engineering was very active in conducting routine exposure assessments from 2009 to 2011. During this time period, over 40 TWA measurements were collected for CHPP Rail and Coal Crew personnel (Attachment 1). Statistical analysis of these results was conducting using the AIHA Industrial Hygiene Statistics (IHSTAT) program in Microsoft Excel (Attachment 2). Forty-one TWA values were used to determine the exposure profile for the Rail and Coal Crew similar exposure group (SEG). Censored data, results below the analytical detection limit, were included in IHSTAT using the substitution method (limit of detection/$\sqrt{2}$). The exposure profile data do not appear to fit either the lognormal or normal distribution. This is likely influenced by the fact that

[3] Docket No. OSHA-2010-0034, Occupational Exposure to Respirable Crystalline Silica - Comments of Robert Lieckfield, Jr. of Bureau Veritas for the U.S. Chamber of Commerce, Docket No. OSHA-2010-0034 (OSHA Docket Office January 27, 2014).

85% of the sampling events were censored (below the analytical detection limit). Empirical evidence is strong that most exposure distributions are skewed to the right and can be reasonably approximated using the lognormal distribution (Figure 1). Thus, lognormal parametric statistics were used.

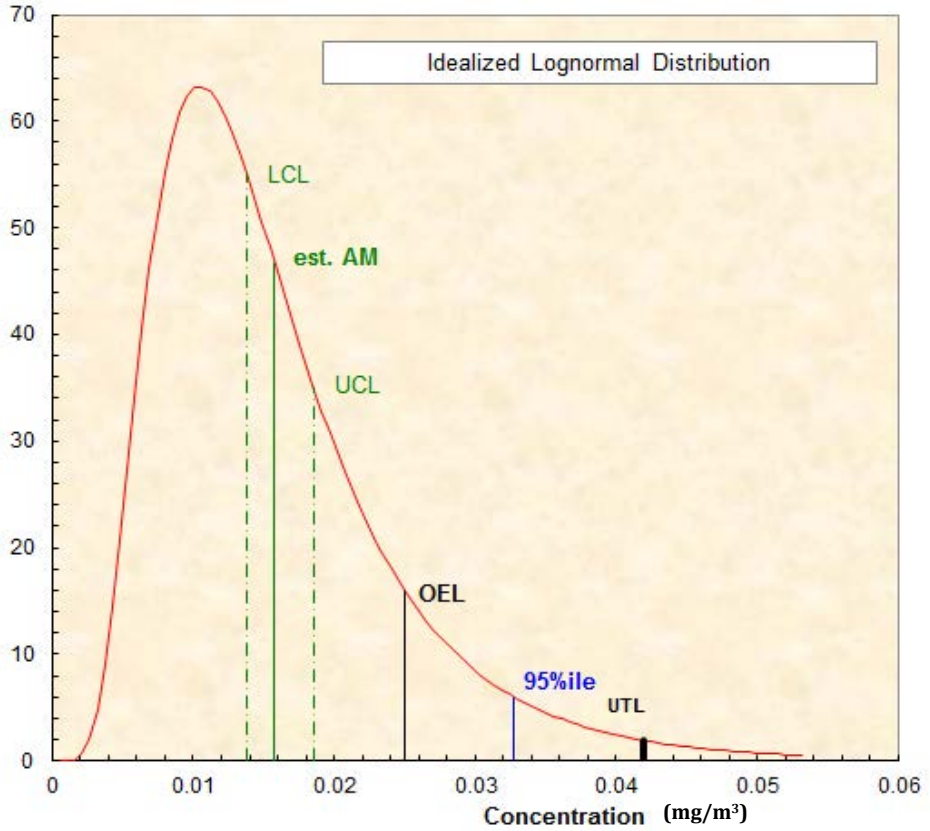


Figure 1. Idealized Lognormal Distribution

The monitoring data were used to estimate the 95th percentile of the SEG exposure profile and calculate a 95%, 95% upper tolerance limit (UTL) for comparison to the ACGIH TLV of 0.025 mg/m^3 (Table 4).

Table 4. Lognormal Parametric Statistics

95th Percentile	0.033 mg/m^3
$UTL_{95\%,95\%}$	0.0419 mg/m^3

Because the 95th percentile and the UTL are both above the ACGIH-TLV, this exposure is rated as "unacceptable." Engineering (if economical), administrative, and personal protective equipment controls should be implemented. If the 95th percentile or the UTL were above the OSHA PEL of 0.05 mg/m^3, engineering controls must be implemented. IAW the proposed rule, compliance monitoring shall be conducted every 6 months based on these statistics. Prior air sampling at the CHPP was limited to Rail and Coal Crew employees; additional monitoring should be conducted to adequately characterize other CHPP SEGs including 253A Power Plant Operations and 253B Power Plant Maintenance.

e. *Medical Surveillance:* IAW the proposed rule 1910.1053(h)(1)(i), the employer shall make medical surveillance available for each employee who will be exposed to silica above the PEL for 30 or more days per year. Medical exams shall include an initial examination (medical and work history, physical exam, chest x-ray, pulmonary function test, and latent tuberculosis test). With the exception of the latent tuberculosis test, initial examinations shall be repeated every 3 years. Currently, the CHPP Rail and Coal Crew SEG and the Maintenance SEG receive all medical surveillance identified in the proposed rule with the exception of the latent tuberculosis test. These tests are documented on AF Form 2766, *Clinical Occupational Health Examination Requirements*. Additional exposure monitoring is required to determine if the Operations SEG is exposed above the PEL for greater than 30 days per year and thus subject to the medical surveillance.

f. *Additional Elements:* The proposed silica rule includes additional requirements similar in nature to existing rules for other OSHA expanded standard substances, including:

(1) Regulated Areas. IAW the proposed rule 1910.1053(e)(1), whenever airborne concentrations of respirable silica are in excess of the PEL, each employer shall establish a regulated area or access control plan.

(2) Employee Notification. IAW the proposed rule 1910.1053(d)(6), employees shall be notified of assessment results within 15 working days after completing an exposure assessment.

(3) Cleaning Methods. The employer shall ensure that accumulations of crystalline silica are cleaned by HEPA-filter vacuuming or wet methods. Compressed air, dry sweeping, and dry brushing shall not be used.

(4) Training. The employer shall ensure that each affected employee demonstrates knowledge of specific operations that could result in silica exposure, exposure control measures, contents of the silica standard, and the purpose of medical surveillance.

4. RECOMMENDATIONS:

a. *OSHA's Proposed Rule:* Eielson Bioenvironmental Engineering personnel should review the proposed rule, available at https://federalregister.gov/a/2013-20997.

b. *Exposure Assessments:* Employee monitoring should be conducted for all CHPP SEGs. As part of the boiler replacement contract, the CHPP is planning on replacing the coal crushers. Future employee monitoring should characterize employee exposures once the new crushers are installed. The respirable silica fraction may be impacted if the new coal crushers have a different size distribution (i.e., the crushers may create more coal dust). Particular attention should be paid to the hazard selected in the Defense Occupational and Environmental Health Reporting System (DOEHRS). Recommended hazard selections include "COAL DUST" and "SILICA, CRYSTALLINE." Inappropriate selections currently used in the Eielson program office include "AMORPHOUS SILICA" and "PARTICULATES NOT OTHERWISE SPECIFIED." "SILICA, CRYSTALLINE CRISTOBALITE" may be selected but only if the presence of cristobalite is indicated in the sample results (less common). Similar attention should be given to

the selection of the appropriate OEEL in DOEHRS. As mentioned previously, the ACGIH TLV of 0.025 mg/m^3 is the recommended OEEL for silica and the ACGIH TLV of 0.9 mg/m^3 is the recommended OEEL for coal dust.

c. *Risk Assessment Code:* A Risk Assessment Code, or RAC 2, was first assigned to the ash handling tasks in April 1995. Inadequate ventilation and dust control in the ash shed (Bldg 6203) is cited as causing high levels of respirable silica in the air exceeding the OEEL. A project to replace the ventilation system was proposed but remains unfunded. During ash handling, ash from the power plant is transferred to the ash shed via a vacuum system, which stores ash in three silos located at the top of the ash shed until the silos are emptied during ash disposal. The silos are emptied by positioning a dump truck underneath the silo. An operator, typically the dump truck driver, lowers the telescopic chute into a hole at the top of the ash box on the dump truck and then activates the screw conveyor, paddle feeder, and throat valve equipment to empty the silos. Simultaneously, a dust suppression system is activated. "Ash boxes" or enclosures were added to the dump trucks to reduce the potential for airborne dust exposure; however, there is no record of when these enclosures were installed. No mention is made of these enclosures in the 2006 consultative letter, AFIOH-DO-BR-CL-2006-0062 (see footnote 1). During Det 3's observations of the ash transfer from silo to dump truck, minimal dust generation was observed. It is Det 3's recommendation that the ash hauling activities be resampled and characterized to account for the reduced exposures due to the ash boxes. If re-characterization indicates employee exposures are above the proposed OSHA PEL of 0.05 mg/m^3, Det 3 recommends the RAC remain open and the issue be elevated to Wing leadership IAW AFI 91-202. Citing the proposed OSHA rule may assist in securing funding. Alternatively, if re-characterization indicates exposures are below the proposed PEL, Det 3 recommends closing the RAC. Det 3 is able to assist in making a RAC determination following SEG re-characterization if desired.

d. *Cleaning Methods:* Dry sweeping was witnessed in the ash shed. As mentioned previously, the CHPP is highly encouraged to purchase a HEPA vacuum for the ash shed. Using wet methods (i.e., mopping) is an alternate option; however, the sub-zero temperatures will likely rule it an invalid alternative. Regardless, dry sweeping and compressed air should not be used for cleaning anywhere in the CHPP where coal dust may accumulate. Dry sweeping and compressed air suspend respirable particulates in the employee breathing zone and increase exposures to coal dust and silica.

e. *Real-Time Particulate Monitoring:* As a component of future risk assessments, the EAFB Bioenvironmental Engineering Flight should consider the use of a real-time particulate monitor. Due to the limit of detection, NMAM 7500 samples must be collected over multiple hours, making it difficult to pinpoint particularly dusty operations. The use of a real-time industrial particulate monitor, in conjunction with breathing zone air sampling, may aid in identifying what processes benefit the most from engineering controls. A HAZ-DUST I hand-held aerosol monitor or similar is best suited for determining real-time respirable dust fractions according to ACGIH/ISO/CEN criteria. Alternatively, Det 3 has an EVM-7 environmental monitor available for loan to EAFB. The EVM-7 is also a real-time particulate monitor, but is designed for environmental health risk assessments with selections for PM2.5, PM4, PM10, and TSP meeting slightly different particulate cut-point definitions.

f. *Extended Shifts:* CHPP personnel routinely work shifts longer than 8 hours. OSHA does not require adjustment of the exposure limit for extended shift periods. Instead, compliance officers are to sample the worst 8-hour period in the shift. However, mathematical models are recommended IAW Air Force Manual (AFMAN) 48-146 and should be used to ensure the daily dose of silica and coal dust during the altered work shift is less than the dose for a conventional work shift. The Brief and Scala method is recommended; refer to Attachment 4 of AFMAN 48-146 for additional details.

5. If you have any questions concerning this survey, please contact me at DSN 315-634-2638 or email at tiffany.heline@us.af.mil. Additional information and references are available in the Bibliography as Attachment 3. I appreciate the opportunity to provide assistance on this project and would like to extend my gratitude to all the professionals in your shop for their cooperation and support.

TIFFANY R. HELINE, Capt, USAF, PE, CIH
Chief, Occupational Health

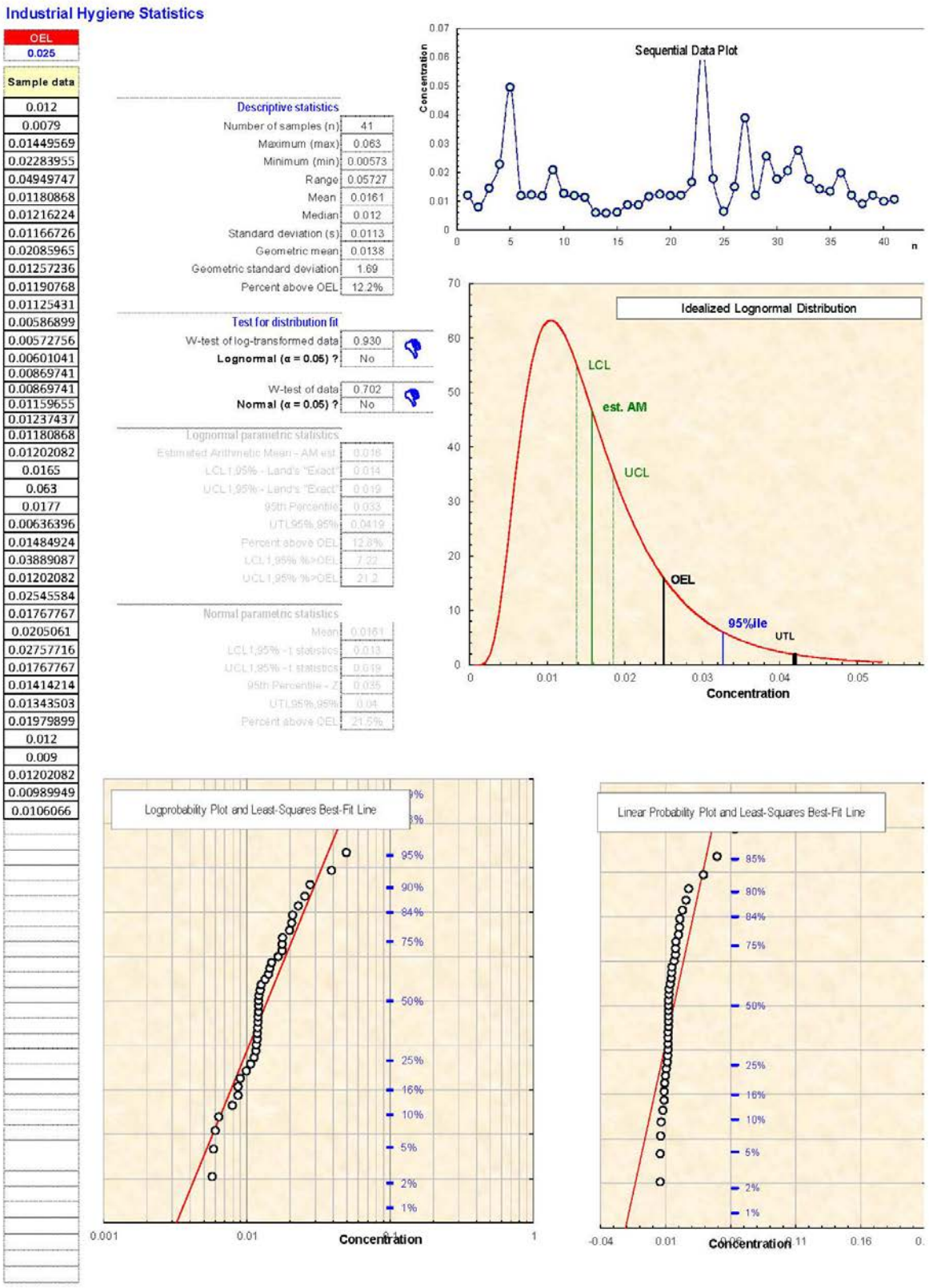
Attachments:
Attachment 1: Rail and Coal Crew TWAs
Attachment 2: Industrial Hygiene Statistics
Attachment 3: Bibliography

cc:
PACAF/SGPB

ATTACHMENT 1: Rail and Coal Crew TWAs

Sampline Date	Operations	Quartz TWA mg/m^3	Censored Value (LOD/√2)	Quartz OEEL mg/m3	Above AL?	Above OEEL?
28-Mar-13	Ash Dumping	0.012		0.025		
22-Jan-12	Bunker Area Clean-up	0.0079		0.0175		
17-Mar-11	Ash Hauling	<0.0205	0.0145	0.025	Y	
17-Mar-11	Floor	<0.0323	0.0228	0.025	Y	Y
28-Feb-11	Ash Hauling	<0.07	0.0495	0.025	Y	Y
28-Feb-11	Floor	<0.0167	0.0118	0.025	Y	
28-Feb-11	Floor	<0.0172	0.0122	0.025	Y	
16-Feb-11	Floor	<0.0165	0.0117	0.025	Y	
10-Jan-11	Ash Hauling	<0.0295	0.0209	0.025	Y	Y
10-Nov-10	Ash Hauling	<0.01778	0.0126	0.025	Y	
10-Nov-10	Floor	<0.01684	0.0119	0.025	Y	
10-Nov-10	Brakeman	<0.015916	0.0113	0.025	Y	
12-Apr-10	Bunker	<0.0083	0.0059	0.025		
12-Apr-10	Floor	<0.0081	0.0057	0.025		
12-Apr-10	Ash Hauling	<0.0085	0.0060	0.025		
22-Feb-10	Floor	<0.0123	0.0087	0.025		
22-Feb-10	Bunker	<0.0123	0.0087	0.025		
22-Feb-10	Ash Hauling	<0.0164	0.0116	0.025	Y	
28-Jan-10	Ash Hauling	<0.0175	0.0124	0.025	Y	
28-Jan-10	Floor	<0.0167	0.0118	0.025	Y	
28-Jan-10	Bunker	<0.017	0.0120	0.025	Y	
21-Dec-09	Floor	0.0165		0.025	Y	
21-Dec-09	Tripper/Bunker Duties	0.063		0.025	Y	Y
21-Dec-09	Ash Dumping	0.0177		0.025	Y	
30-Nov-09	Floor	<0.009	0.0064	0.025		
30-Nov-09	Tripper/Bunker Duties	<0.021	0.0148	0.025	Y	
30-Nov-09	Ash Dumping	<0.055	0.0389	0.025	Y	Y
22-Oct-09	Floor	<0.017	0.0120	0.025	Y	
22-Oct-09	Ash Dumping	<0.036	0.0255	0.025	Y	Y
22-Oct-09	Tripper/Bunker Duties	<0.025	0.0177	0.025	Y	
9-Jul-09	Floor	<0.029	0.0205	0.025	Y	Y
9-Jul-09	Tripper/Bunker Duties	<0.039	0.0276	0.025	Y	Y
8-Apr-09	Ash Dumping	<0.025	0.0177	0.025	Y	
8-Apr-09	Coal Unloading	<0.02	0.0141	0.025	Y	
8-Apr-09	Tripper/Bunker Duties	<0.019	0.0134	0.025	Y	
11-Mar-09	Floor	<0.028	0.0198	0.025	Y	Y
11-Mar-09	Ash Dumping	0.012		0.025		
11-Mar-09	Tripper/Bunker Duties	0.009		0.025		
6-Mar-09	Tripper/Bunker Duties	<0.017	0.0120	0.025	Y	
6-Mar-09	Brakeman	<0.014	0.0099	0.025	Y	
4-Feb-09	Floor	<0.015	0.0106	0.025	Y	

ATTACHMENT 2: Industrial Hygiene Statistics



ATTACHMENT 3: Bibliography

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